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Symons, Roy
Front end loader
operation and
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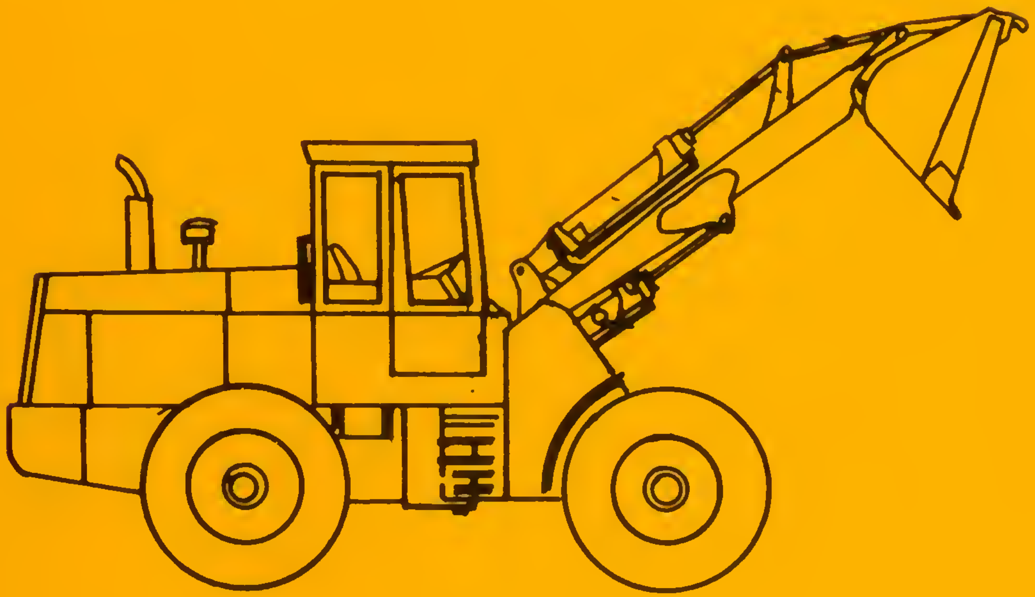
FRONT END LOADER

OPERATION AND MAINTENANCE MANUAL



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FRONT END LOADER
OPERATION AND MAINTENANCE MANUAL

MONTANA DEPARTMENT OF HIGHWAYS
MAINTENANCE AND EQUIPMENT DIVISION

PLEASE RETURN

November 1985 Revised

ROY SYMONS - TRAINING OFFICER
MAINTENANCE AND EQUIPMENT DIVISION

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MONTANA DEPARTMENT OF HIGHWAYS
MAINTENANCE AND EQUIPMENT DIVISION

FRONT END LOADER
OPERATION AND MAINTENANCE MANUAL

GENERAL RESPONSIBILITY

This manual has been prepared for the field maintenance employees who are responsible for the operation and daily maintenance of the Department's front-end loaders. The information in this manual is general in nature, to cover the several makes of loaders owned by the Department.

You are not expected to be a trained mechanic, but you are expected to know enough about the equipment you operate to recognize mechanical defects that might occur while you are operating it. You are not required to diagnose trouble when it arises, but you must be able to describe on an EMS-2 Shop Job Order the symptoms you have noticed or to decide when the trouble is serious enough to shut down a piece of equipment.

PURPOSE

The purpose of this manual is to keep employees informed and aware, of the proper use and maintenance of equipment to ensure that it operates well and allows you to do a job that you can take pride in.

To evaluate this program you will be tested on this material at the beginning and end of the classroom presentation. This will enable us to determine if this program is achieving the desired results. If you get less than a 70% score on the second test, you will be retested at another date. This will give you additional time to review this manual on your own. You will then be evaluated individually through an operational field test.

GENERAL INFORMATION

The most advanced development of the bulldozer is the front-end tractor shovel or front-end loader. It can be used for digging, loading and limited transportation of material.

Loaders do not have springs, this improves the stability but at the expense of some operator comfort and grading control.

Some loaders are equipped with torque converters, or with power shift transmissions. The main clutch is usually fitted with ceramic or bronze discs instead of a lining, or operates in a circulating bath of oil that both cools and lubricates. This construction avoids the problem of slipping and wearing the clutch and improves lugging qualities when digging. Power shift capabilities, particularly between forward and reverse, increase flexibility and shorten cycles.

The frame is composed of a massive weldment fastened to the central frame. It carries the pivot or hinge pins for the push and dump arms and their hydraulic rams and transmits the weight, thrust and twisting strains of the loader to the tractor. Any independent movement of these parts should be tightened or welded before any damage is done.

The push arms (Fig. 1, P.3) are hinged to the top of the frame, and extend downward to hinges near the bottom of the bucket. A heavy cross beam braces them near the front.

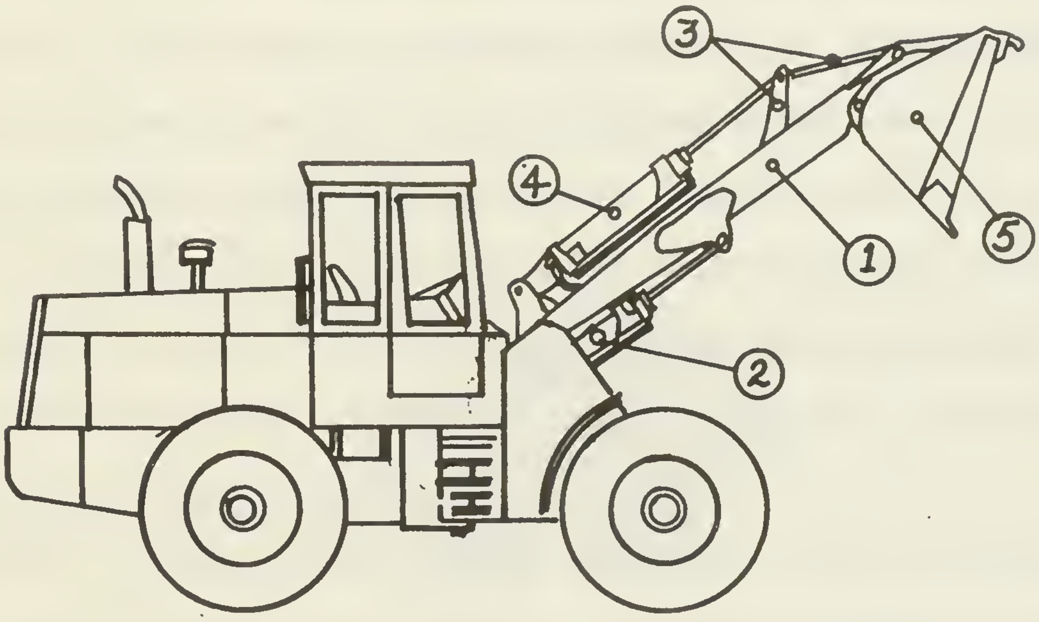


Figure 1

1-Push Arm 3-Dump Arms 5-Bucket

2-Lift Ram 4-Dump Ram

Dump arms are usually composed of one to three arms hinged to levers that pivot on the sides of the push arms. They are fastened to the dump ram piston rods at the rear, and to the bucket in front. The compound construction serves to increase rigidity, and to multiply the applied force through use of leverage.

The bucket is of simple box construction. A heavy cutting edge of tempered steel runs along the front and part way up the sides. The upper back curves forward. Buckets are usually the same width as the outside of the wheels.

The standard bucket has three working motions. It is raised and lowered by two-way rams controlling it through the push arms, it is tilted or rolled between carrying and dumping positions by the dump rams and linkage, and it is crowded and retracted by the forward and reverse travel of the tractor. Pivot points on the bucket should be greased twice a day when used continuously.

Dumping height is the elevation above ground level of the lip of the bucket in dumped position. It may be several feet below the height of the lip to carrying position, and 1-1/2 to 2-1/2 feet below the bucket hinges.

Manufacturers seldom supply figures on hoist speed, but the bucket may generally be lowered at about twice the speed it is raised. The load in the bucket and the engine rpm can greatly influence these cycle speeds.

The bucket will usually tilt more than 100 degrees between dump and full back positions. At maximum height dumping slope of the bottom is 45 to 50 degrees. At ground level a bucket that is not rolled back may be kept tipped down for float grading while moving forward.

The bucket angle necessary will depend on the material in the work area. Experience will improve your ability to judge the angle needed, when going ahead or back dragging so the bucket will not cut into or ride over material you are trying to smooth. The build-up of material in front or back of the bucket will fill the low spots and the high spots will be trimmed.

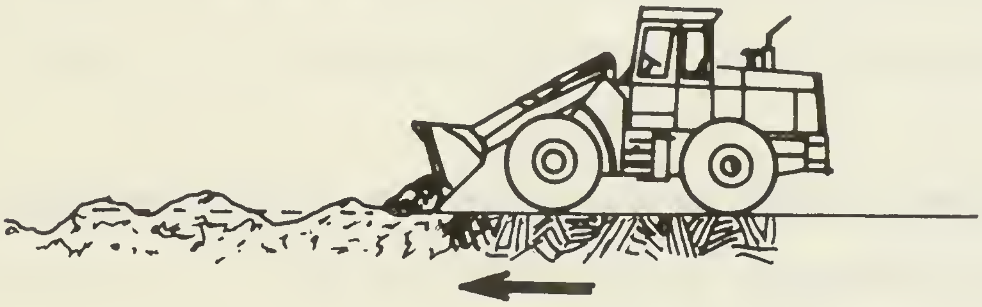
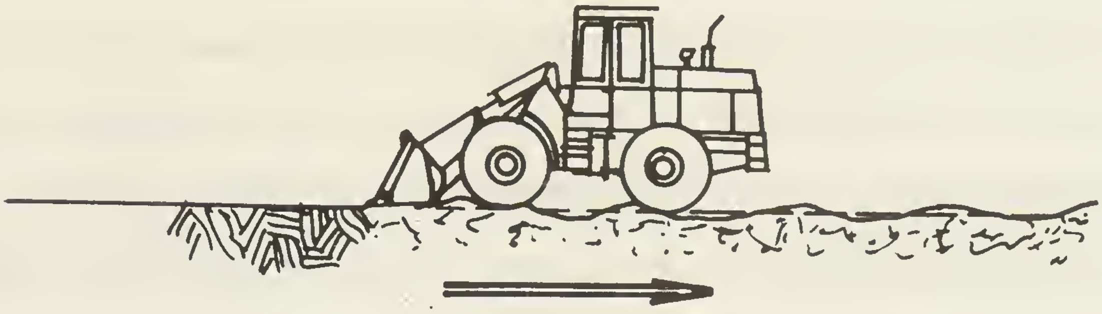


Figure 2



Exercise caution when moving material with the bucket in full dump position. This is the weakest bucket position for the cutting edge and the hydraulic cylinders.

Some machines can roll the bucket back so that the floor has an upward slant of 40 or more degrees at ground level; others cannot tip back from horizontal position. A bucket that rolls back is a great advantage because it can apply prying or breakout force in a bank that is much greater than the hoist power, without pulling the front of the tractor down. Rolling back is useful in slicing upward in hard or heavy banks and in picking up and carrying heavy, heaped, or sloppy loads and oversize objects. It improves balance, by moving the load toward the tractor.

A roll-back bucket usually has an indicator on the dump ram to tell the operator whether it is flat or tilted.

SAFETY FIRST - PROCEDURES

Prevention of accidents involving powered equipment is completely dependent on the person in charge of the equipment. The manufacturer incorporates features to make the operator's job safer and controls to make it easier, but AVOIDING SITUATIONS WHICH MIGHT CAUSE ACCIDENTS IS SOLELY UP TO THE PERSON AT THE CONTROLS, AND DEPENDS ON THE FORESIGHT, JUDGMENT AND SKILL OF THE OPERATOR. A careful operator is the greatest safety device there is. Stop accidents before they stop you.

The foot brake must be applied and the engine can only be started in neutral so the machine cannot move suddenly when the engine begins to operate. The loader will have well positioned steps with adequate hand holds so the operator can easily climb to the seat without having to step on a tire or other parts of the machine which might be slippery.

With all these safety features which have been incorporated in the design of the loader there are still the dangers of injury to persons working near the loader. Therefore the operator must be extremely careful in the operation of this machine. To help prevent accidents the following safety rules should be observed at all times:

1. Become well acquainted with the equipment and the Operator's Manual.

2. All power equipment should be operated only by those who are responsible and trained to do so.

3. Obey the information on the decals which are located on the loader in areas of possible danger.

4. For safe operation, inspect and perform proper maintenance and repair of all pivot pins, hydraulic cylinders, hoses, snap rings and main attaching bolts prior to each day's operation.

5. Keep the operator's platform free of debris.

6. Always face the machine and use the hand holds and steps when mounting and dismounting from the loader. NOTE: Never jump from a machine, or dismount from the loader when it is in motion.

7. Clean you shoes of slippery materials to prevent slipping on steps, or slipping off the clutch or brake pedals.

8. Keep the windshield, windows and mirrors clean at all times.

9. Remove the keys from the ignition before servicing or repairing the loader.

10. Never operate any of the controls from any position except when seated in the operator's seat.

11. Stay clear of the hinged area if engine is running or the steering wheel is being moved. Even with engine off, moving steering wheel on accumulator-equipped machines may cause rapid pivot of wheels and frames.

12. Never leave the engine running while the loader is unattended.

13. Always lower the loader bucket to the ground or block the push arms and wheels securely before performing any service

operation. Park in a clear, level area, lower the bucket to the ground, shift all controls to neutral and set the parking brake.

14. Keep the bucket as close to the ground as possible when transporting loads or when the bucket is not in use.

15. Never refuel the loader when the engine is hot or running.

16. Do not smoke when refueling or using starter fluid.

17. Never operate the machine in a closed shed or garage. Provide adequate ventilation.

18. Do not oil, grease, or adjust the machine when the engine is running.

19. Drive at speeds slow enough to insure safety and complete control, especially over rough terrain.

20. Be careful when working on banks or hillsides.

21. Increase the power gradually when pulling a heavy load or when driving out of a ditch or excavation.

22. Always keep the loader in gear when going down steep grades; NEVER COAST.

23. Reduce the engine speed when turning or applying brakes.

24. Keep the work area as smooth as possible, avoid spinning the wheels and digging dangerous ruts. If material spills from the loader bucket and leaves a pile of dirt or rocks on the working surface, clean it up immediately.

25. Never work under raised equipment or motor vehicles unless they are properly blocked with blocks which will not crush.

26. Keep the brakes in proper adjustment. If you can't stop the machine, don't start it.

27. Grease pivot points on the bucket every four hours when the loader is being used continuously.

28. Never make repairs or tighten hydraulic hoses or fittings when the system is under pressure, when the engine is running, or when the hydraulic cylinders are under a load.

29. Do not remove the radiator pressure cap when the radiator is hot.

30. Be careful when using cold-weather starting fluid. Always have the engine cranking when fluid is sprayed. Wait at least ten minutes before using starting fluid if you have attempted to start the engine with a manifold heater. Crank

the engine 5 - 10 seconds before attempting to use a manifold heater to clear the cylinders if you have used starting fluid.

31. Always disconnect the battery ground strap before welding on any part of the unit. This will prevent dangerous sparks which create a fire hazard and may cause injury or equipment damage. Disconnecting the battery also prevents accidental operation of the starter. Batteries can explode with the force of several sticks of dynamite.

32. Never permit persons other than the operator to ride on the loader.

33. Do not wear loose fitting clothing which may catch in the moving parts, be careful with rings and wrist watches.

34. Never attempt to lift loads in excess of loader capacity or use the loader as a battering ram.

35. Sound the horn before moving the loader.

36. Always look behind the loader before backing up.

37. Always be sure of water, gas, sewage, electrical, and telephone line locations before you start to dig.

38. Always check overhead clearance, especially when transporting the unit. (Know your maximum height before transporting.)

39. To help prevent highway accidents, use working signs, red flags, flaggers and turn on yellow flashing cab lights whenever working on the road surface. Display the "Slow Moving Vehicle" emblem.

40. Never attach chains, ropes, or cables to the rollbar for pulling purposes; use the drawbar provided.

41. It is the responsibility of the operator on each shift to inspect the loader. The use of defective or unsafe equipment is forbidden.

42. Look for leaks and check fluid levels.

43. Use common sense and good judgment.

PRE-START CHECK LIST

Before starting your loader each operating period, or shift, check the following:

1. Check oil level in crankcase, be sure it is between full and add line on dipstick.

2. Check all lubrication fittings; service according to directions in the Operator's Manual. Use a clean rag to wipe dirt off of fittings before greasing.

3. Check the transmission fluid and fill to proper level.

4. Check the air cleaner each shift or more frequently depending on working conditions, be sure it is clean and connections are tight, check hoses for cracks and leaks. Excessive smoke or loss of power could indicate a dirty filter.

5. Check the radiator; keep it full and keep the grill work and radiator fins free of debris and oil accumulation.

6. Check fuel tank; fill it with clean, water free fuel.

7. Drain any accumulated water or sediment from fuel tank water trap.

8. Inspect the fuel system for leakage; check the engine for coolant or crankcase oil leakage.

9. Check all the belts; they should be just tight enough to eliminate slippage. Proper deflection depends on the distance between the pulleys.

10. Check the hydraulic power steering; make sure the fluid reservoir is filled.

11. Check air pressure in the tires, keep them inflated according to manufacturer's specifications, _30 to 50 pounds_.

12. Check the oil level in the hydraulic reservoir. Only add oil of the type specified in the operator's manual, or its equivalent.

13. Check for loose bolts, nuts, visible cracks and unusual play at hinge points.

14. Be sure to check the cutting edge on the bucket for wear, neglecting this area can cause serious bucket damage.

15. Check the welds on the bucket hard face for wear.

STARTING PROCEDURE

To Start The Loader Engine

1. Be sure the bucket and push arm levers are in neutral.

2. Engage parking brake.

3. Put the range selector lever in neutral.

4. Be sure the fuel shutoff lever is pushed all the way in, if the unit is so equipped.

5. Depress the foot throttle to the one-half open position.

6. Turn key switch to start position (extreme right) or depress the starter button and hold it to engage the starter and crank the engine.

7. When the engine starts, release the key or button which will return to run position.

8. If the engine fires and stops, allow the starter motor to stop spinning before attempting another start.

9. Do not operate the starter motor for more than 30 seconds at one time. Wait at least two minutes between each cranking so the starter motor can cool.

10. While the engine is being cranked with the starter, white or black exhaust smoke should be observed at the top of the exhaust pipe. If no smoke is observed and the engine won't start, it indicates that no fuel is getting into the cylinders.

11. Immediately after starting the engine, do not accelerate the engine above 825 rpm until the oil pressure gauge reads 5-15

psi. If the engine is equipped with a turbocharger, idle the engine for approximately two minutes, to ensure adequate lubrication. Do not "race" the engine during the warm-up period. Do not operate the engine at full governed RPM until properly warmed up.

12. If the engine fails to start using warm weather starting procedures, refer to the cold weather starting procedure, in the Operator's Manual, for the equipment you are trying to start.

13. Do not try to start the loader by towing it.

During Operation Checklist

1. Check ammeter, engine oil pressure, fuel gauge, horn, back up alarm and engine temperature gauge.

2. Check the clutch pressure gauge; it must be registering in the operating zone. This gauge indicates the pressure at the control valve which actuates the transmission clutches.

3. Check the brakes to see if they are holding properly. If it won't stop, shut it down. Do not operate equipment you can't stop.

4. Operate the Bucket Control levers and observe the action of the bucket. Inspect the hoses and connections for evidence

of oil leaks and defects. This warms up hydraulic oil in cold weather, and saves wear and tear on the hydraulic pump.

5. If chains are required, chain up all four wheels on four-wheel drive units.

"CAUTION"

Never idle the engine for long periods of time. Unburned fuel will wash down cylinder walls causing poor lubrication and dilution of the crankcase oil. Heavy carbon formations will form on the valve system causing serious damage to the engine.

DRIVING THE LOADER

After the engine has warmed up, throttle down to idle speed and shift the speed range selector lever to either high or low range.

Shift the direction and selector lever to forward or reverse and release parking brake. Increase engine speed as necessary.

Avoid operating the loader continuously at or near a converter stall speed condition and high RPM with the wheels not turning. If the loader has been operating in high range and the converter temperature gauge pointer nears the red zone, downshift from high to low range to avoid overheating and damage to the transmission.

"CAUTION"

If the temperature gauge pointer enters the red zone, stop loader immediately, place transmission in neutral and run engine at half speed until the pointer goes well back into the green zone.

STOPPING PROCEDURE

Park the unit on as level a surface as possible, lower the bucket to the ground, put the shift lever in neutral, and apply the parking brake.

Cool the engine by running at about a quarter throttle for about three (3) minutes before stopping the engine.

Turn the key to the "off" position or pull the stop control all the way out, or both.

After Operation Checklist

1. Fill the fuel tank with clean fuel.

2. Conduct a walk-around inspection, so you know what to bring the next day to service your loader.

3. Clean the unit if needed.

4. In extremely cold weather park the loader inside or cover it with a tarp. You may have to remove the battery and store it in a heated area, don't place it directly on a concrete floor.

5. Report needed service to your Supervisor.

TRANSPORTING

A loader is an off-the-road vehicle and is not designed for long distance travel over the road. A few simple procedures related to loading and transporting equipment will make things easier on you and the loader.

When approaching the trailer raise the bucket enough to clear the ramps, but not so high that it obstructs your view. Shift to low gear and start up the ramp very slowly to avoid jarring as the center of gravity shifts. Position the loader on the trailer, lower the bucket to the deck, position all control levers in neutral and set the parking brake. Always follow proper shutdown procedures and allow adequate cooling time. Fasten two chains from the draw bar to D-rings toward the rear of the trailer. Fasten a chain to each side of the bucket and to D-rings on the opposite side of the trailer. Check all load binders for proper tension.

Cover the exhaust stack to prevent damaging the turbocharger. Even sitting on a trailer the wind forced down the stack during transit can spin the turbo enough to cause serious damage. When the engine is not running this unit receives no lubrication, a short trip with an uncovered stack could cause irreparable damage.

Towing

The loader can be towed at slow speeds for a distance not greater than 1/4 mile. Do not tow a loader unless no other means of moving it is available. Use a rigid type coupler when towing.

IMPORTANT: If the loader is to be towed in excess of 1/4 mile, the front and rear axle driveshafts MUST be disconnected to prevent damage to upper bearings and shafts that do not receive lubrication when the engine, converter and charging pumps are inoperative. Transporting a loader on a trailer is preferred to towing which should only be used in emergency situations.

HYDRAULIC SYSTEM

Loader hydraulic pumps are usually mounted at the front of the engine for direct drive by a crankshaft extension. Capacities are large, varying from 15 gallons per minute upward.

The reservoir holds up to 60 gallons of oil and is equipped with filters to remove outside dirt and wear products. It may be a closed system, or an open one with a filtered air vent. It is important to keep the oil at the proper level. Too little will allow the system to draw air and perform unevenly; too much may cause oil to squirt out of the vent or build up damaging pressure under loads.

Fluid escaping under pressure can have sufficient force to penetrate the skin, causing serious personal injury. Before disconnecting lines, be sure to relieve all pressure. Before applying pressure to the system, be sure all connections are tight and that lines, pipes and hoses are not damaged. Fluid escaping from a very small hole can be almost invisible. Use a piece of cardboard or wood, rather than your hands, to search for suspected leaks.

If you are injured by escaping fluids, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately.

LOADER CONTROLS

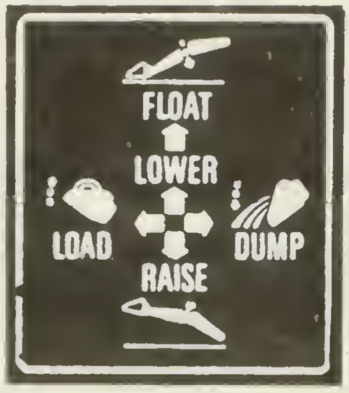
Loaders are equipped with either one or two levers to control the push arms and the bucket. Always use smooth gradual movements on control levers. This gives you more control over the equipment, thus the work you accomplish, and is less demanding on the equipment.

On the two lever system, the lift control lever controls the raising and lowering of the loader arms. The lever positions are float, lower, hold and raise.

The bucket tilt control lever controls the dump and roll back action of the bucket. The lever positions are dump, hold and roll back.

On a single control lever system, move the lever forward to lower and backward to raise the push arms. The bucket rolls back when the lever is moved to the left and dumps when moved to the right. (Fig. 3, p. 22)

Figure 3



Hold (Neutral):

When the loader control lever is in the center position the bucket and push arms will maintain their relative positions.

Forward:

The loader push arms will lower under pressurized oil from the hydraulic pump. Foward lever position causes down pressure on the push arms.

Full Forward (Detent):

Moving the lever to the full forward position establishes "float." The push arms will lower under their own weight and will follow the contour of the ground.

Rearward:

Moving the control lever rearward raises the push arms.

Right:

Moving the control lever to the right will dump the loader bucket. The hydraulic valve will use pump pressure to dump the bucket, a load in the bucket will multiply this force.

Full Right (Detent):

At a full right position, the loader bucket dumps through the force of the load. Use caution; heavy loads may cause bucket and hydraulic cylinder damage.

Left:

Moving the control lever to the left will cause the loader bucket to roll back.

Full Left (Detent):

When the control lever is moved to the full left position, the return-to-dig feature is activated and the loader bucket automatically returns to a level position.

Note: By moving the control lever forward while the lever is in the full left (detent) position, the loader arms will lower as the return-to-dig feature is functioning.

AUTOMATIC CONTROLS

Some machines have a dump linkage arranged so that a bucket that is flat when on the ground, automatically tilts when a few feet above the ground. If this tilt back is not wanted, the operator may use the dump control to counteract it.

Automatic kickouts are installed to stop the hoist at maximum or some other selected height, and to return the bucket to digging angle after dumping. Such devices allow the operator to use both hands on the tractor controls while maneuvering.

LOADING THE BUCKET

Place the speed range control lever in the first (1) gear position and the directional control lever in the forward (F) position. Place the transmission range lever in the low position. Lower the bucket with the lift arm control lever. Use the bucket control lever to position the cutting edge and bottom of the bucket parallel to the ground (bucket indicator pointers coincide). Drive the machine slowly forward to push the cutting edge into the pile until the bucket is nearly full (Fig. 4, p. 25). Alternately pull the lift arm control lever and the bucket control lever back a little at a time so the lift arm raises and bucket tips back a little at a time. Continue until the bucket is full. Push the lift arm control lever to the HOLD position. Move the direction control lever to the reverse (R) position and back out of the pile. Keep the load low and bucket slightly tipped back and carry the load to the dumping area.

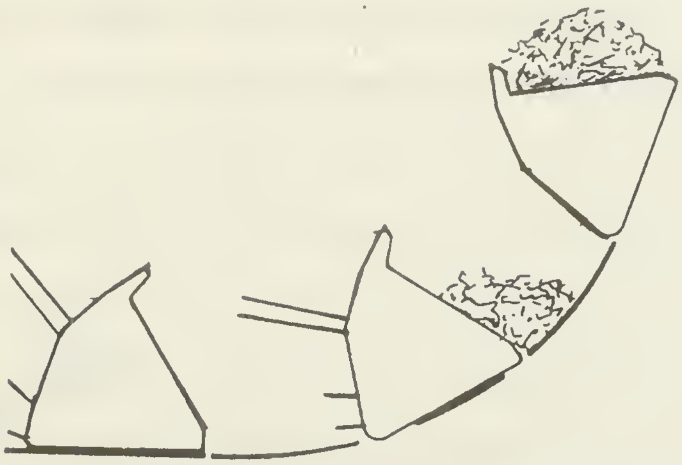


Figure 4

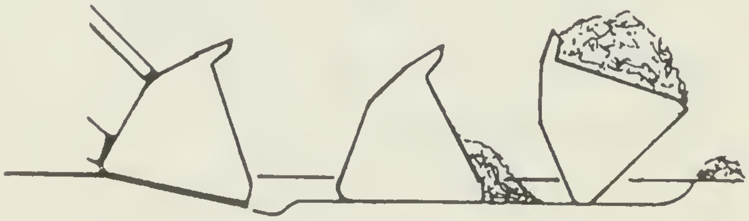
DIGGING - BUCKET ANGLE

Most loader digging is done with the bucket flat or tilted to a slight downward angle. This position gives maximum penetration into banks and high spots, and cuts a smooth path on which the wheels can follow.

Some buckets do not roll back but are flat when the dump rams are fully retracted. For them, this is the best angle both for digging and for raising and carrying a load.

For cutting down into hard dirt, (Fig. 5, p. 26) the bucket should be tipped downward ten to thirty degrees. When it has penetrated to a depth of two to six inches, it should be flattened all the way while the forward motion of the tractor is continued until the bucket is filled. This combines good original penetration, sturdiest position of the bucket for most of the pass, and a powerful prying effect during the change in angle. Under some soil conditions continual minor adjustments of the angle while digging helps penetration.

Figure 5



RAMPING DOWN

If the digging is downward, as in cutting an excavation or a ramp, hard material may require pitching the bucket bottom at a ten to thirty degree angle to the line of the wheels, and cutting in thin slices. The downward pitch of the ramp should be gradual, as the machine is nose heavy with a loaded bucket and may tip over frontward in backing out of the hole.

GRADING AND EXCAVATION

When grading or excavating, adjust the bucket so the bucket position indicator shows the bucket is in a level position (pointers coincide). Tip the bucket forward toward the DUMP position slightly to get penetration. When the cutting edge penetrates, use the bucket control lever to adjust the bucket to the desired cut, and to prevent excessive penetrating or digging in. Move bucket control lever slightly forward and back to obtain a smooth, even grade. To hold a proper grade, the foot throttle should be depressed to half throttle in first (1) or second (2) gear, low range. When the bucket is full, or the end of the cut has been reached, pull back on the bucket control lever, until it is in "TILT-BACK" position and the bucket rests against the stops then raise the push arms slightly off the ground for carrying the load.

TRANSPORTING THE LOAD

When transporting the load, travel speed of the machine will depend on the length of the haul and type of surface over which the machine must travel. Rough terrain and sharp turns require fairly slow speeds. Carry a loaded bucket approximately 14 inches above the ground. Never transport a load with the bucket raised more than halfway. Hold the bucket as near to the ground as conditions permit to improve visibility and the stability of the machine, especially on slopes or when turning.

DUMPING THE BUCKET

Raise the bucket with the lift control lever until it clears the top edge of the truck side or dumping bin. Keep the machine perpendicular to the truck side or bin so the load can be dumped evenly inside the dumping area. When the bucket has reached the proper height, place the lift arm control lever in the "HOLD" position and push the bucket control lever to the "DUMP" position slowly and gradually. Do not suddenly push the bucket control lever all the way forward -- the load may dump too quickly and could damage the truck body or hydraulic cylinders on the loader. After the bucket has emptied, pull the bucket control lever to the TIP BACK position, look behind loader, sound the horn and back the machine away from the truck or bin. Place the lift control lever in the position to lower the bucket. Proceed back to the pile to get another load.

Large heavy material like riprap or boulders require special consideration and treatment to protect the truck being loaded. Load smaller material first to cushion the box against the shock of larger material. Dump from the lowest possible height as slowly as possible. Dump material so it will not damage the bottom or the offside of the box.

TRAVELING WITHOUT A LOAD IN THE BUCKET

When moving the machine to another job, the empty bucket should be approximately 14 inches off the ground, in rolled back position. Travel speed of the loader will depend on the type of surface over which the loader must travel. Do not drive the machine in reverse to attain higher speed or more steering control. The operator has relatively poor visibility over the rear hood of the machine and fast, continuous rear travel may cause the engine to overheat. The impact air coming through the radiator from traveling backward neutralizes the air flow from the pusher fan and can cause the engine to overheat.

STOCKPILING MATERIAL

Raise the bucket full of material just high enough that you can see under the bucket while sitting in the operator's seat on the loader. If the bucket is raised too high, the material in the bucket can fall back down on the windshield or operator when you drive up on the pile.

Be very careful when going up on the pile to dump the loaded bucket to see that the wheels on the loader go up on the pile evenly. If one wheel goes up on the pile and the other wheel goes to the side of the pile, the loader will tip over. A ramp is sometimes helpful, but care should be taken to avoid roll overs.

Travel distance up on the pile is determined by how high you want to pile the material. Travel up the same distance on the pile for each bucket full, this will help eliminate vacant spaces for water to collect and damage the material. Keep the top of the pile as even as possible. When proper height on the pile is reached, dump the bucket and step on the brake, at the same time, to hold the loader up on the pile. When the material has dumped, place the direction selector lever in reverse and back slowly down off the pile. DO NOT COAST BACK DOWN IN NEUTRAL, you will come down too fast, and could have an accident or damage the loader.

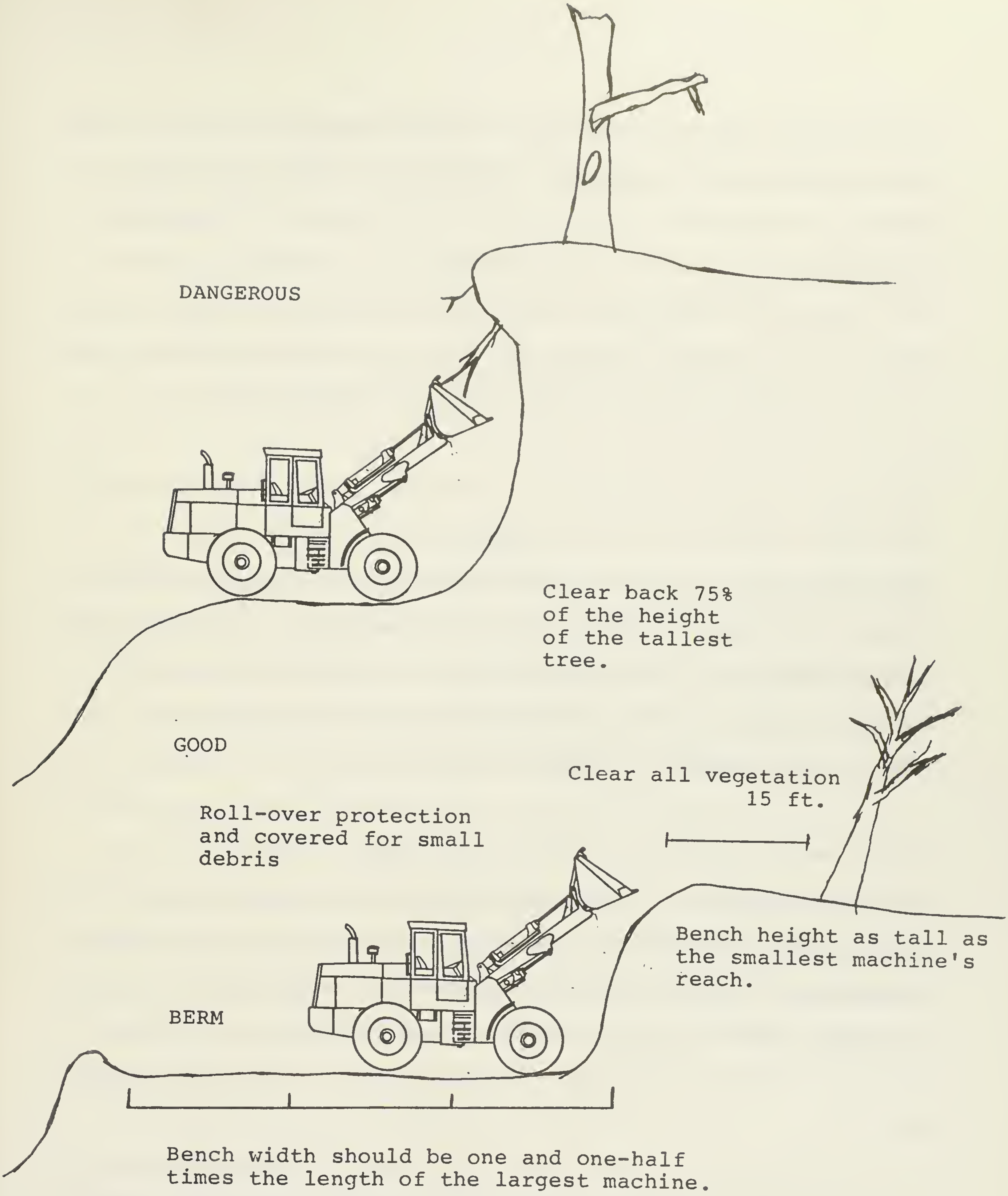
Stockpiling operations can be performed safely by following the above instructions and always staying alert for potential hazards.

The flat position is best for pushing a quantity of loose dirt, but the bucket should be turned down steeply for spreading and grading it so that dirt will flow freely off the bottom into holes, and so it will not be pulled down by sticky soil. Care should be taken not to hook into solid obstructions at a steep angle, as the bucket is then in its weakest position, and leverage against the dump mechanism is at its maximum.

The depth of cut may be regulated either by the hoist or the dump rams. For any given position of the push arms the edge will be the highest when flat and two or more feet lower when fully dumped.

DIGGING BANKS

The bucket has weak penetration in relation to the power and weight of the machine. The hoist is very slow compared to the speed of the loader, so that the bucket tends to get under more dirt than it can break loose and lift.



Clear back 75% of the height of the tallest tree.

Clear all vegetation 15 ft.

Roll-over protection and covered for small debris

Bench height as tall as the smallest machine's reach.

Bench width should be one and one-half times the length of the largest machine.

BENCHING AND WORKING FACE DIAGRAMS

Figure 6

If the bank is of hard material it is desirable to keep it sloped back to facilitate breaking out the loads. This may be done by digging in layers down from the top of the bank, then slicing upward from the bottom. The slope may be maintained by making each cut parallel with it. It takes a few seconds longer in each cycle to dig this way because of the extra distance traveled, but it may be easier for the machine than digging in chunks.

The loader bucket is pushed into the bank in flat position until the loader starts to lug down, then alternately hoist and roll the bucket back. Continue forward motion only enough to keep the bucket in the bank as its tilting rotates it out. Any additional forward push on a rolled back bucket may damage it, and won't improve the dig. Crowd, curl and lift motions combined in a smooth combination will produce good results.

If the bank is only two or three feet high, it may be dug by keeping the bucket at final grade and running beside the bank, cutting into it as much as possible without shoving the loader excessively. The cutting will be done by the side and bottom of the bucket which is in the bank. The soil will roll along the bucket and fill it, although the load will be heavier on the bank side.

If the machine is driven head-on into the bank and gets under too great a load, the bucket may become stuck and the back tires will come off the ground. In this case the loader should be shifted into reverse and backed out. As soon as the bucket is pulled back slightly in the bank, it will rise and usually pull out with a good load.

Working under high banks and on benches requires additional safety considerations to avoid cave-ins from above and roll-overs. Recommended safety practices are illustrated in figure 6.

PAYLOAD

The amount picked up in the bucket varies with the nature of the material, slope of the bank, the surface to be driven over, and the skill of the operator. A standard one yard bucket load will vary, from one-half to one and a half yards, and should average seven-eighths of a yard to a yard in medium digging. Roll back buckets usually get bigger loads than flat ones do.

When dumping close to the digging point, as in side casting, or loading a properly placed truck, keeping up a fast cycle is usually more important than getting maximum loads with each pass. As distance to the dump point increases, capacity loads become more important.

If the load must be carried over rough ground or backward up a slope, it should be limited to the weight the machine can carry easily without tipping.

If the bucket does not fill sufficiently the loader should be backed, the bucket lowered to ground level, and another pass made. If the load is one sided the second cut should be made at an angle to the bank so that the empty side will penetrate first.

It is often difficult for the operator to judge the amount in the bucket unless the digging is easy enough to permit dirt to be forced up to the top of the back of the bucket.

GOUGING

A common difficulty in digging heavy soils is that the penetration of the bucket is so good that it will be pulled down by the slice it has dug, raising the back of the loader. This may be combatted by keeping the bucket as flat as possible, or by tipping the bucket bottom into a nearly vertical position which eliminates the problem but puts extra strain on the bucket.

In heavy soils it is sometimes best for cycle time to let the bucket gouge, and make an extra pass to grade off the area as necessary.

TRANSPORTING MATERIAL

If the ground between digging and dumping is hard and smooth, backing, turning, and dumping can all be done at speed with safety, by carrying loaded bucket below eye level. If the ground is rough the loader must move slowly, as going over a bump or ridge with a heavy load may cause the loader to tip forward and the bucket to strike the ground. If this happens, the operator should be alert and lower or dump the bucket if an upset starts. Lowering bucket all the way has the effect of taking the bucket weight off the loader to enable it to recover its balance.

Dropping a loaded bucket and stopping it abruptly in the air may burst a hoist ram hose or overbalance the loader again and cause it to tip forward.

If the bucket is carried as close to the ground as possible, the consequences of overbalancing are unlikely to be serious.

The bucket should not be given a high lift if there are rocks or lumps projecting over the back, as they might fall and injure the operator or damage the loader. Normally such things fall to the ground, or on the front of the loader without serious damage, but they might roll down the arms or bounce back. This danger is greater when the operator's station is at the front of the loader.

TRUCK LOADING

This discussion is based on the popular small loaders with bucket sizes of approximately 2 yards. All operations are described as manually controlled. In many machines of this size and larger, some of the responsibilities are taken over by automatic kickout devices. These devices simplify operation, but do not change its principles. The loader operator has some added responsibilities beyond simply operating the loader. It is his job to see that no truck is overloaded. Spillage over the sides of the truck causes wasted material plus a traffic hazard in the roadway. He must also see that the stockpile is not contaminated. Example: a stockpile of grade aggregate could be contaminated by carelessly spinning the tires and rutting the floor of the work area. Efforts to clean up could cause unclean or larger material to contaminate the pile. The larger material could foul or damage some of the machinery the material might be transferred to, or the surface it is applied to.

MANEUVERING THE LOADER

Generally, the actions involved in loading a truck are as follows: The loader is headed toward the pile or bank, is put in low range, the throttle is opened, and the bucket is lowered until it almost touches the ground. As the bucket enters the bank the hoist lever is moved to UP position so that the bucket will rise as it penetrates. When it is filled, the direction selector is changed to reverse, and the machine backed out. The hoist lever may be moved to HOLD when the bucket is a few feet above the ground.

When backing, the loader should be turned so that it faces toward the side of the truck to be loaded. It is then shifted into forward, the hoist lever moved to UP, and the machine driven forward. The bucket should be lifted high enough so that the downward movement of the bucket lip during dumping will not cause it to strike the truck, and it is good practice to have it high enough to clear the side to avoid accidents while backing. The hoist is usually completed before the truck is reached. The control is then moved to HOLD and the loader moved so that the bucket is over the truck body.

A good procedure is to time the lift so that the bucket will safely clear the truck as it is moved over it and the control can be left in UP during the dump. When the dump valve is opened it "robs" the hoist valve so that lifting stops, to begin immediately when the dump valve is closed. This "live" bucket is more easily controlled over the truck body than when the hoist is on HOLD.

In either case, the loader is driven forward until the bucket is as far over the body as desired. Do not hit the truck side, tires or gas tank. The dump lever is moved forward to dump load. Always dump the first bucket or two slowly to reduce shock to the truck. If the soil is sticky the bucket may be shaken by banging against the dump stops by moving the dump valve lever rapidly back and forth. Do this with care, you can cause a hose to burst! Look behind the loader, place in reverse, and back away, the bucket lip being raised to clear the body if necessary. When clear of the truck, the machine is stopped, put in forward, and headed toward the bank, the bucket put in digging position and lowered during the return trip.

Easy digging, proper truck spotting and smooth stock pile area favor a fast cycle. Most machines are capable of 15 to 30 second cycle times.

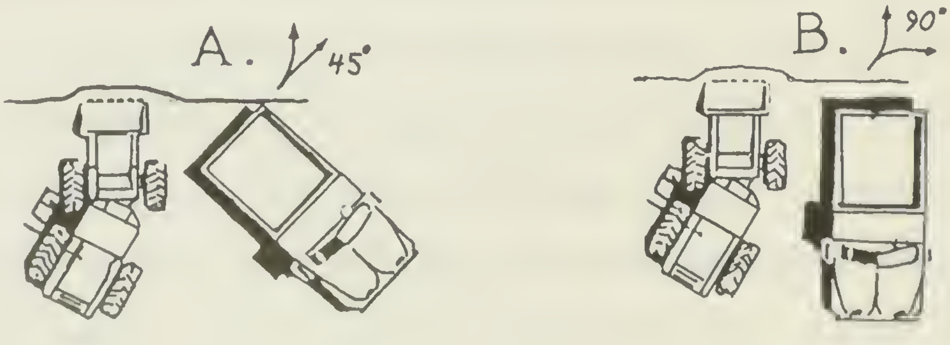
Cycle Time: The time it takes to load the bucket, dump the bucket, return to the pile.

SPOTTING TRUCKS

There are many possible patterns of digging and dumping.

In (Fig. 7A, p. 38) the truck is parked at an angle of about 45 degrees to the bank, so the loader's turns are only half as sharp. In this position some loads can be swung from the bank onto the truck with a very short backward movement, thus increasing loading speed. This is the best system, in terms of time and movement.

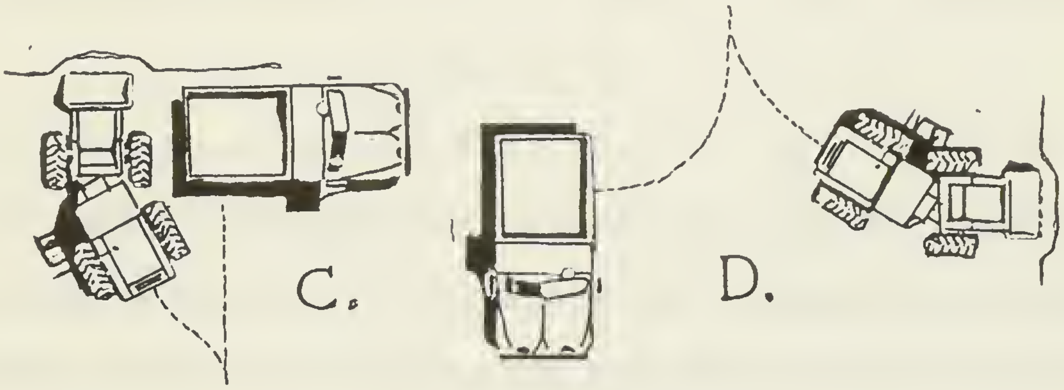
Figure 7



Although it is not best, (Fig. 7B, p. 38) is the most used method, in which the side of the truck is at right angles to the face of the bank. This involves a quarter turn twice in each digging cycle. The turn may be difficult in soft or very rocky ground and the wheels are subjected to considerable turning stress and side wall scuffing.

In (Fig. 8C, p. 39) the truck is parked parallel with the bank and the digging is done just behind it. This involves about the same amount of turning as 7B with a greater amount of walking.

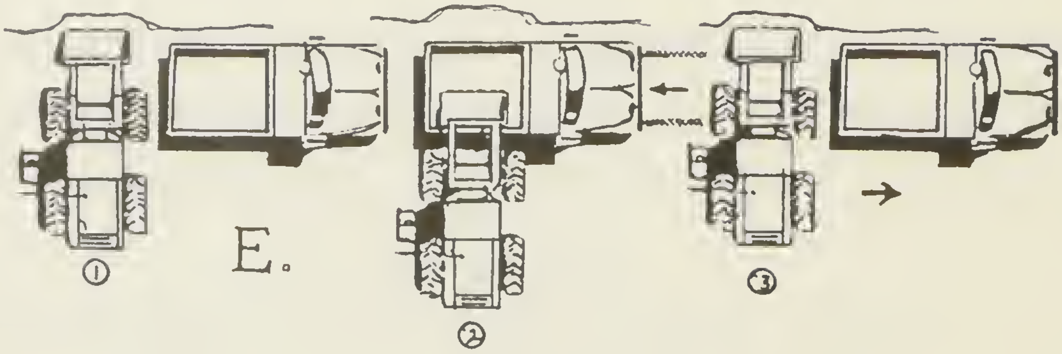
Figure 8



In (Fig. 8D, p. 39) the truck is parallel to the bank but at a distance from it, so that the tractor must make a half turn with each load in order to get it in the truck, and another half turn to get back to the bank. More walking is required than in other methods. This is the slowest and most unsatisfactory of the arrangements suggested, but is often used in muddy or sandy pits where trucks are restricted to certain drives.

In (Fig. 9E, p. 40) the truck is again parallel to the bank, but it comes to the loader for each bucketful. The machine fills its bucket from the bank and backs straight away. The truck backs in front of it; the tractor advances and dumps into the truck; the truck moves forward; the loader takes another bite; backs up; and waits for the truck to come back.

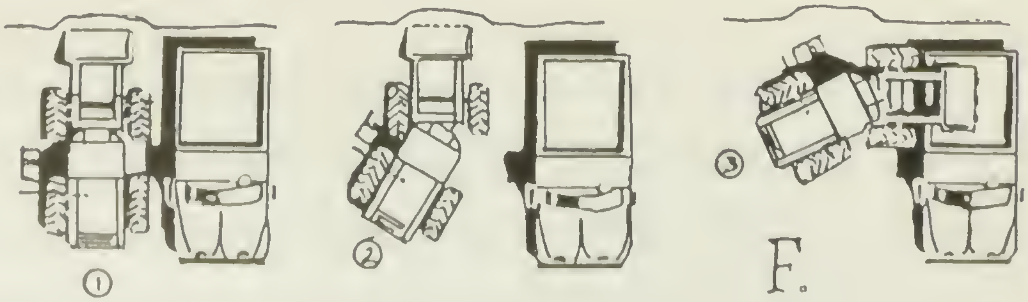
Figure 9



This method involves no turning, is fast and efficient if properly coordinated, and keeps wear on the tractor to a minimum. It is particularly valuable when the soil is loose and very abrasive, so that it would wear the tires rapidly if it were worked into them by steering. However, this method is so unpopular with truck drivers that it is seldom used.

(Fig. 10F, p. 40) shows the effect of counter-rotating tracks in shortening travel.

Figure 10



Loader output can usually be increased substantially by having a spotter place the trucks, or by training the drivers to be alert to the needs of the machine so that they will not only take a convenient position, and be ready to move if the machine works away from them. This last is particularly important where the digging is shallow and truck bodies large.

DUMPING IN BODY

The width of the buckets on the popular size loaders varies from 5 to 6-1/2 or 7 feet, and the truck bodies to be filled are usually between seven and eleven feet long. A short body can be given a full heaped load by dumping in the center only. A long body can be given a good load by dumping alternately in the front and rear from the side, but there is a tendency to pile up in the center and skimp the corners.

Clearance under the conventional one yard bucket edge in fully dumped position is over seven feet, but the machine is at its best in loading trucks with sideboard heights of six feet or less. At this height the loader dumps about three feet ahead, which makes it possible to slide the load to the far side of the truck if necessary, and the operator can see into the body. With increase in lift the bucket moves back toward the loader and loses reach, so that a truck with sides seven feet high would require extra work moving the load across the body or loading from both sides.

HIGH TRUCKS

Many loaders now have sufficient dumping height and reach to load the largest bodies readily without the special procedures described below.

If a body is too high for convenience, a heaping pile of soil is built up on one side. This heap may be moved toward the other side by pushing it with a loaded bucket held with its bottom parallel with the ground and just clearing the sideboards.

The bucket is then dumped and its load pushed over by the next bucketful, this process being repeated until the body is full.

Dirt may also be worked over by putting the bucket in fully dumped position, dropping it just inside the body and rotating it part way toward flat position.

Very high trucks may be loaded by using both sides. The bucket must be rotated to flat position after each dump in order to be pulled back over the side.

If several big trucks are to be loaded and the pit floor must not be torn up, a few bucketsful will build a ramp on which the loader can get an easy working height. The ramp should be made with a level area at least 1-1/2 times the length of the loader. If the machine is tipped up steeply while dumping, reach is reduced and the effort of holding position increases.

If there is uneven distribution of earth front and rear while loading, it may be corrected by cutting into the bank at an angle so that the side of the bucket which will dump over the low spot will get the heaviest part of the load. Dirt already dumped can sometimes be rearranged with the bucket in dumped position by pushing, pulling, or turning.

DISTANCES

The loading is fastest if the truck is close enough to the digging that the loader just has room to turn. The loader can load at considerable distances but a steadily diminishing returns on a yards-per-hour will occur. When a pit is too wet or sandy for truck operation the loader can dig in the pit, carry material onto firm ground, and load the truck.

The operation of digging in one place and dumping or stockpiling in another is similar to truck loading if it is desirable that the space between the digging and the dumping should not be disturbed. If the distance is short, 50 feet or less, or a big yardage is to be moved, it is usually more economical to push the material with a flat bucket, as the machine will push from two or three times as much dirt as it will carry, which on a short run will more than compensate for slower speed.

Carrying may be done in the top gear or high range on smooth ground, while pushing requires low or second. If the loader has only a single reverse, its return trip is slow in either case, and on a long carry it will pay to turn it around for a fast run back to the pit. The return trip may also be used occasionally to level the ground, either by pushing or back dragging, but at a slow controlled speed.

OUTPUT

The rule of thumb is that a front-end loader will load trucks at an average rate of 50 bank yards an hour for each yard of bucket struck capacity.

Under very favorable conditions this rate can be doubled. Conditions are more often unfavorable, however. Loader operations are sometimes carelessly performed and excessive time losses are caused by poor truck spotting, long travel distances between bank and truck, and soft working areas.

Conditions get unfavorable much more easily for loaders than for shovels, their production diminishes rapidly as the digging becomes harder or coarser, or the footing gets softer. On the other hand, an alert foreman and a good operator can often get superior loader production simply by using good procedures.

HANDLING OVERSIZE OBJECTS

Loader buckets are not well adapted to picking up large loose objects on the ground. They tend to push ahead of the edge unless it is dug into the ground under them, and the overhang of the back makes it hard to balance anything bulky on the floor of the bucket.

Roll-back buckets can pick up many objects by getting the edge under them, then tilting back the bucket until they fall in. Larger pieces, such as stumps or boulders, may be crowded against a steep bank which will prevent them from falling out when the bucket is lifted high enough so that the bottom will slope back. Two loaders can lift the object between them until it settles into one of the buckets. Use care not to overload the bucket.

If the object is too large to be picked up in this way or there is nothing to crowd against, it can be maneuvered onto the bottom of the bucket and kept there by a chain hooked to the top back of the bucket. This method is especially effective with loose stumps resting upright.

A load usually settles back as it is raised or tilted back so that it is easy to unhitch before dumping. If it settles forward and puts so much tension on the chain that it cannot be released, the bucket may be lowered so any overhang is supported by the truck sideboard or the pile. The chain may then be removed and the load boosted into position.

The bucket may also be lowered over a loose stump in dumped position, and attached by a chain or chain and tongs. The bucket is raised and flattened and the stump is pried up by the edge to nearly floor level.

For efficient application of these methods, it is essential to have a chain grab bracket built onto the top of the bucket. For use in dumped position, a second bracket on the rear beam is desirable.

A chain should not be anchored on a push arm and passed over the top of the bucket, as these change their relative positions during a lift, and the chain is likely to be stretched and broken.

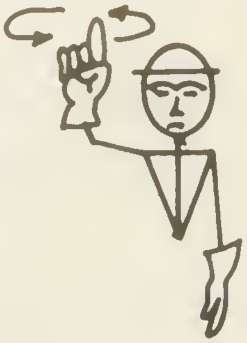
SIGNALING

There has been some concern expressed by some field personnel, in regard to hand signals. A given hand signal in one section may get the load dumped, while in another section the same signal might get the loader shut down.

Although there are no mandatory signaling codes, certain ones have become standard through use. These signals apply to scrapers, motor patrols, and dozers, in heavy highway construction. In our maintenance activities, we often find ourselves in a situation where we use a loader to do what these other machines usually do on large scale projects.

In some situations the loader also doubles as a crane, in small lifting operations. For this reason some basic crane signals are also shown.

1. Raise the load - Point a finger up and rotate your hand.
2. Raise the load slowly - Point a finger up an rotate your hand while holding the other hand over it.
3. Lower the load - Point a finger down and rotate your hand.
4. Lower the load slowly - Point a finger down and rotate your hand while holding the other hand underneath.
5. Raise the boom - Point up with your thumb.
6. Raise the boom slowly - Point up with your thumb, while holding your other hand over it.
7. Lower the boom - Point down with your thumb.
8. Lower the boom slowly - Point down with your thumb, while holding your other hand underneath.
9. Swing - Point in the direction desired with your arm out straight.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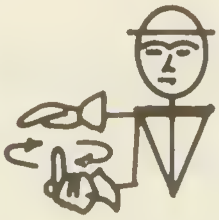
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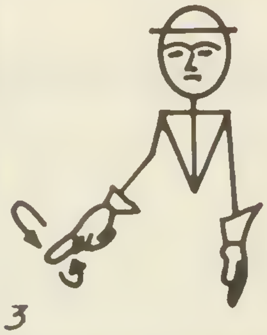
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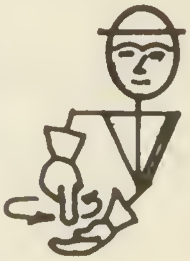
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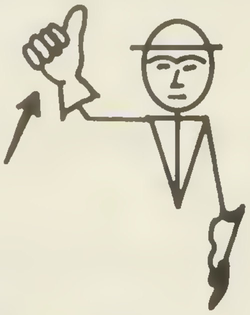
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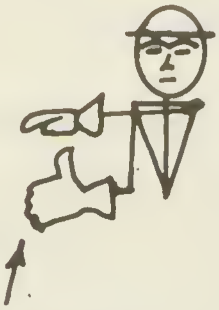
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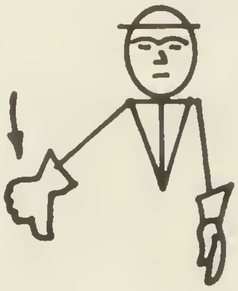
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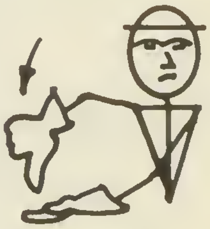
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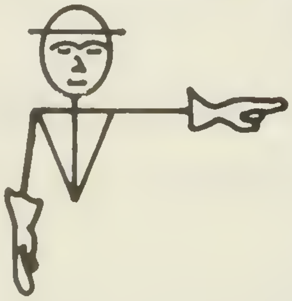
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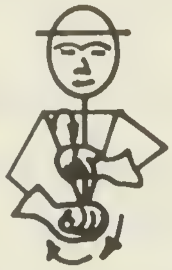
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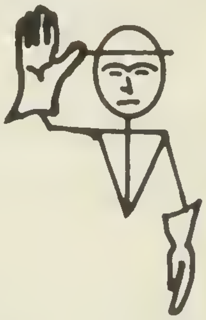
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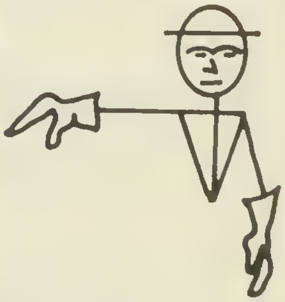
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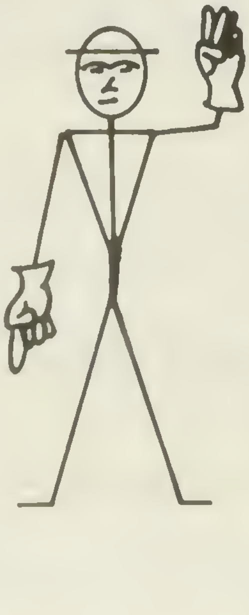
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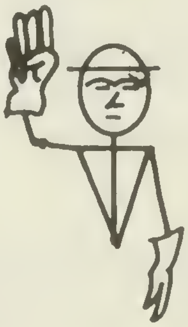
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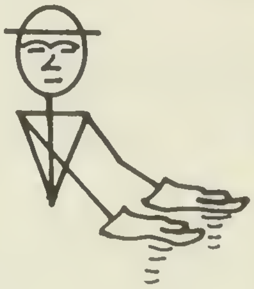
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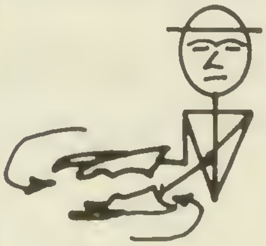
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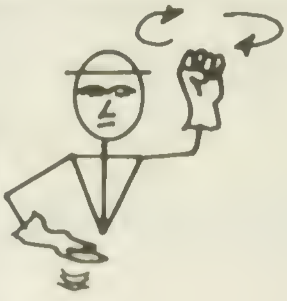
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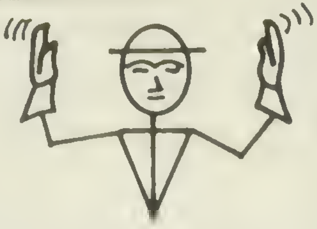
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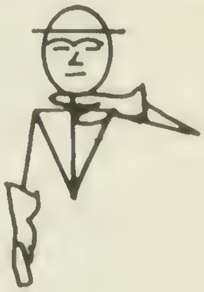
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10. Travel - Roll both fists around each other in front of you.

11. Stop - Hold up your hand like a traffic cop.

12. Dump - Extend your arm and with your hand open, point down.

13. 3' to cut or spread - The number of fingers held up on the left hand indicates the number of feet to be cut or spread. Pointing at your foot indicates the count means feet.

14. 3/10' to cut or spread - The number of fingers held up on the right hand indicate per 10th of a foot (slightly more than one inch): one finger for 1/10th, two fingers for 2/10ths.

15. Raise 'er up a little - To carry blade higher, indicate lifting motion with tips of fingers.

16. Smooth it up - Point to the area, then rub palms together indicating smoothing motion.

17. Get out of the area - Make lifting motion with tips of fingers for lighter cut, then follow it immediately with rotating motion of a raised fist.

18. Slow and easy - Raise both hands and flex fingers. Clenching both fists indicates all motion of machine should stop immediately and hold all brakes.

19. Shut the engine down - Use "cutting your throat" gesture.